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P.O. Box 1450
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CLAIM OF PRIORITY

Sir:

Applicants in the above-identified application hereby claim the right of priority in connection with Title 35 U.S.C. § 119 and in support thereof, herewith submit a certified copy of Finnish Patent Application 20000226, filed on February 3, 2000.

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Dated: June 28, 2004

Edward W. Grolz

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E T U O I K E U S T O D I S T U S
P R I O R I T Y D O C U M E N T

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Keksinnön nimitys
Title of invention

"A process for hard panning of chewable cores and cores produced by the process"
(Menetelmä pureskeltavien ytimien kovapäällystämiseksi ja menetelmällä tuotetut ytimet)

Täten todistetaan, että oheiset asiakirjat ovat tarkkoja jäljennöksiä patentti- ja rekisterihallitukselle alkuaan annetuista selityksestä, patenttivaatimuksista ja tiivistelmästä.

This is to certify that the annexed documents are true copies of the description, claims and abstract originally filed with the Finnish Patent Office.

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A PROCESS FOR HARD PANNING OF CHEWABLE CORES AND CORES PRODUCED BY THE PROCESS

The present invention relates to a process for the hard panning of chewable cores in a rotary pan wherein a syrup containing crystallizable sugars and/or polyol(s) such as xylitol is intermittently sprayed over a bed of the cores and the cores are dried between sprayings with a flow of air. The invention relates especially to the improved control of the panning process which enables a faster panning and thereby a considerable saving in the time required for providing cores with hard coatings. The invention also relates to cores panned by a process according to the invention and especially to chewing gums coated with a hard coating of xylitol.

The art of coating or panning is described generally e.g. in the article "Crystallisation and drying during hard panning" by Dr. Richard W. Hartel (Manufacturing Confectioner, February 1995). According to the document too fast drying causes problems and for proper results it is important that the crystallization and drying are in balance. Crystallization and drying should proceed at the same speed so that each layer is set before the next layer is sprayed on. If drying is too rapid, a rubbery skin is formed on the surface trapping the water in the layers below.

Consequently, the panning technology has provided long drying times to allow the crystallization to proceed properly in the layer. On the other hand long drying times increase the cost of panning. With compounds such as xylitol and sorbitol, the solubility and viscosity of require low temperature panning (see "Coating with sorbitol. A Comparison of properties of sorbitol-mannitol other polyols and sugars" by Francis Devos, Roquette Freres, Manufacturing Confectioner, November 1980).

The panning or coating with xylitol and other polyols is described also in the following patent publications:

US 4,423,086 (Devos, assigned to Roquette Freres)
US 4,753,790 (Silva, assigned to Warner-Lambert Company)
US 4,840,797 (Bousier, assigned to Roquette Freres)
US 5,248,508 (Reed et al, assigned to Wm. Wrigley Jr.)
US 5,270,061 (Reed et al, assigned to Wm. Wrigley Jr.)

US 5,376,389 (Reed et al, assigned to Wm. Wrigley Jr.)
US 5,536,511 (Yatka, assignee Wm. Wrigley)
EP 813 817 (Cerestar Holding)

In these patents various panning techniques with polyols such as sorbitol, xylitol and mannitol are discussed. In many cases the coating with xylitol is regarded as being complex, slow and costly.

Xylitol is rather broadly used in non-cariogenic chewing gums, confectionery and pharmaceuticals. However, it is considered a rather expensive raw material. If the panning procedures could be speeded up cost savings could be obtained. Thus, there exists a need for a quicker and more effective coating process for xylitol, and also for other coating compounds.

It has been found that most of the heat needed for the drying during panning derives from the drying air, and that only a minor part comes from the heat of crystallization. Thus, it is possible to control the panning procedure by controlling the drying conditions.

The present invention seeks to provide improvements in panning procedures to alleviate the problems discussed above and to provide a product with equal or improved quality and shelf-life. The invention in its broadest sense is applicable also to panning with other polyols and for the control of panning with sugars.

The present invention is defined in the appended claims which are incorporated herein by reference.

Thus, the present invention relates to a process for controlling the hard panning of chewable cores in a conventional coating pan or perforated drum, such as a rotary pan, wherein a syrup containing crystallizable sugars and/or polyol(s) is intermittently sprayed over a bed of the cores and the cores are dried between sprayings with a flow of air. The invention is characterized in that the control of the drying time is based on the relative humidity of the outlet air from the pan.

In another aspect, the present invention concerns a process for the hard panning of chewable cores in a rotary pan wherein a xylitol syrup is intermittently sprayed over a bed of the cores and the cores are dried between sprayings with a flow of air. According to the invention the temperature of the bed of chewable cores is raised to a temperature of 25 to 45 °C, preferably 30 to 40 °C, for at least a part of said coating procedure. The drying

during said part of the procedure is performed with air having a temperature of 25 to 75°C, preferably 30 to 65°C. The drying during said part of the procedure is controlled by controlling parameters of the drying air so as to prevent undue dusting and to obtain a hard and smooth coating with a good shelf life.

In its product aspect, the present invention provides a chewable core panned by a process as defined above. The core is preferably a chewing gum coated with a hard coating of xylitol.

The present invention makes the coating process quicker and more effective and still produces a product with a comparable or better crunch and shelf-life. This achieved with a controlled process wherein the conventional drying temperature (about 20 °C) is raised to a higher temperature. Using a high temperature in the panning with xylitol was clearly against the judgement of the person skilled in the art. However, it was surprisingly found that with proper control of the drying parameter, the high temperature panning resulted in good quality cores while the process time was reduced as much as 40% from the standard procedure. The coating quality was in many cases superior to the standard process. The coating and core crunch was also superior to standard cores and the cores had an improved shelf-life compared to cores produced by standard procedures.

In the preferred embodiment of the invention the drying process is controlled by the relative humidity of the outlet air. The drying times can be significantly shortened with the higher temperature drying, and set times can be obtained from the measured relative humidity values.

The present invention will now be described in greater detail with reference to some practical examples. The description is primarily made with reference to xylitol as the coating syrup but it is evident that in many instances the control principles are applicable also to panning with other polyols and sugars.

In conventional panning processes a balance between crystallization and drying is considered a prerequisite for achieving a proper results. According to the present invention that balance is not the desired result. Instead the target is an optimum intermediate product for which good crunchiness can be obtained in the final product. By utilizing the invention more benefits from the special solubility, viscosity and crystallization properties of xylitol can be gained. It was found that high bed temperatures preferably 30 to 40 instead of the conventional 20 °C shortened the coating process significantly.

In the preferred embodiment the first coating cycles are performed at normal temperature (about 20 °C) to make good start up. Thereafter the temperature is raised and then most of the cycles are performed with hot drying air, and, preferably, the final coating steps are again performed at normal temperature to provide typical post treatment conditions.

The high temperature drying period is preferably controlled by monitoring the outlet air humidity. The drying is completed when the air humidity is back at the basic level. Any drying performed after the humidity in the outlet air is the same as that of the inlet air is superfluous and only impairs the product. An increased dusting is observed and the product quality is lowered.

According to the preferred drying of the present invention the drying is stopped before the relative humidity of the drying air has reached the basic level. The drying is stopped when the relative humidity of the outlet air is 1 to 10 percentages higher, preferably 2 to 8 percentages higher than that of the basic level. This means that an amount of moisture is intentionally left in the coating. Although not wishing to be bound by any theory, it is believed that when the high temperature drying is used, the balance between drying and crystallization is not achieved. By leaving some moisture in the coating the later crystallization of the xylitol is improved and the crunch and quality of the product after tempering is improved.

It should be noted that both the quick drying provided by the high temperature and the residual moisture in the coating are contrary to normal panning principles.

The cores may be coated in any conventional coating apparatus. The cores normally rotate in a coating bed. Coating (xylitol) solution is fed in cycles to the coating apparatus. The coating apparatus rotate essentially all the coating time. The target is to get chewing gum having smooth coating layers of a sufficient thickness. Thus, up to 100 or more cycles can be applied. Normally about 50 to 60 cycles are applied for chewing gums.

In the coating process according to the present invention the coating is made in cycles which include (i) syrup spraying; (ii) rotating without spraying air; and (iii) drying.

A syrup including xylitol is sprayed on the rotating bed. During the rotation syrup spreads as uniformly as possible on the pellets or cores. Basically as much as possible syrup is sprayed, but if too much is added the cores tends to adhere to each others. Then the drying air is supplied to the apparatus. The core material of most chewing gums or the like heat sensitive material does not tolerate too high drying temperature. Therefore it is

preferred in the first cycles to use drying air with a standard ambient temperature to create "protective" layers. After the protecting layers are formed the temperature of the drying air is raised and the higher air temperature gradually raises also the bed temperature.

Based on trials performed in practice, it seems that 30 to 40 °C is an optimum bed temperature for producing a good quality coating. Temperatures above 40 °C, although providing a rapid drying and hardly any sticky surfaces, may cause other problems such as the gum pellet softening or distorting.

By using a high drying temperature a sensitive and demanding process is created. According to the invention, the process is, however, controlled by monitoring the outlet air humidity (moisture concentration of the outlet air), the air flow rate and/or the direction of the air.

In the beginning of the drying cycle the moisture content of the outlet air increases rapidly and then starts to decrease. Towards the end of the cycle the decrease in humidity becomes slower and the removal of the moisture from the layer is minor - the rest of the water is more difficult to remove from the layer. According to the preferred embodiment of the invention the during cycle is stopped before the drying is completed. When a suitable humidity is reached the drying is interrupted.

It has been found that the dusting problem which has previously prevented utilization of higher drying temperatures is alleviated by parameters of the drying air. Thus, the relative humidity of the drying air is preferably monitored and the drying air is stopped slightly before the layer is fully dried out. Another separate or supplementary procedure is to blow the drying air in a direct flow (with the air flowing from above the bed through the product) instead of the conventional reverse flow (from below the bed through the product). This measure surprisingly reduces dusting and provides an improved quality product. The flow rate of the drying air can also be used to control the drying of the layer.

The suitable time applied the drying air depends on the apparatus used. When suitable parameters are once found the apparatus can be adjusted to work accordingly.

After the drying phase the next cycle begins with: spraying phase, rotating and drying phase. In the latest cycles conventional drying temperatures are preferably used and the air flow may be changed to reverse flow. Coating cycles (usually about 60 cycles) are applied until suitable coating is received.

The coated product thus produced is not finished and ready to be packaged - it is still an intermediate. After the coating process the xylitol in the coat is not totally crystallised. The intermediate is removed from the coating apparatus and fed to a storing tank. Tempering air is supplied to the tank in order to get the product tempered or conditioned. The final crystallization takes place in the conditioning tanks only, the crunchiness of the product is created.

Significant improvements in the capacity of panning of gum pellets and the like products with xylitol are achieved when high temperature conditions are optimised.

The syrup spraying temperature is generally maintained at 40 to 80 °C, typically about 50 °C. The chosen temperature will depend on the concentration of the syrup and the drying conditions. The spray may, for instance, have a concentration of 72% (65% xylitol & 7% gum arabic) dry substance in the sealing syrup, and 74% (72% xylitol & 2% gum Arabic) dry substance in the coating syrup. The syrup preferably contains about 40 to 80 % xylitol on the total weight. It generally contains about 1-10 % or more, up to about 20 % gum arabic on the total weight. The syrup may also contain other additives such as flavours, pigments, special sweeteners, active ingredients, etc. The additives should be chosen so as not to adversely affect the crystallization process. Some insoluble additives may even accelerate the crystallization by providing crystal growth centers.

Two kinds of syrup (sealing and coating) are generally used The first type of coating (sealing) contains more gum arabic and has a multiple role;

1) to seal the core and slow/prevent moisture migration between core and coating and vice versa 2) to prevent the coating from being friable (i.e. stick the coating to the pellet firmly, so that it will not flake off) 3) make the coating more flexible 4) form a good base for the main coating coats.

The first syrup (sealing) is typically used until an increase in pellet weight of typically about 10% has been achieved, then the coating syrup is used to build up the remainder of the coat. However, as this coating is designed to protect and act as a "key" for the further coats, it is important that the pellets are well coated with this material before progressing to the coating syrup, and this is conventionally done visually or by "feel".

In addition to pure xylitol coatings, the present invention is suitable for providing hard coatings from solutions containing also other dissolved and/or suspended polyols, especially special sweeteners such as lactitol, maltitol, mannitol, isomalt, etc. Sorbitol is

generally not suitable in the combination since sorbitol disturbs the crystallization of xylitol.

The direction of the air flow during the period of high temperature drying is preferably direct, while it is often preferred to use a reverse flow when drying at a conventional temperature in the initial period and/or at the end of the coating. The direction of the flow of air may also be changed at other times during the coating procedure, for instance to alleviate dusting problems.

The temperature of the drying air may also be changed during the cycles themselves. Warm or hot air may be used in the beginning of the drying cycle and colder air during the end of the cycle, e.g. 1 to 2 minutes of warm/hot air and 1-2 minutes of cold/cool air.

The following examples illustrate coating according with the present invention using xylitol. The Examples should only be taken as illustrations of some embodiments of the invention and should in no way be considered as limiting the invention. It is obvious to a person skilled in the art that the industrial processes in question may be further optimized once the principles according to the invention are known.

Examples 1 to 6

Examples 1 to 3 were conducted on a batch size of 350 kg pellet centres, coated to a 50 % weight increase. Examples 4 to 6 were conducted on a batch size 60 kg pellet centres, also coated to a 50 % weight increase. The sealing syrup composition was xylitol 65 %, gum arabic 7 %, water 28 %; the coating syrup composition was xylitol 72 %, gum arabic 2 %, water 26 %.

The panning conditions, parameters and the process times are set out in Table 1.

Table 1

Batch no:	1600/4	1600/5	1600/3	1200/4	1200/5	1200/6
Inlet air temp, °C	22	40	35	35-48	36-60	35-68
Outlet air temp, °C	21	33	32	31-33	31-40	33-40
Bed temp, °C	22	35	30		35	40
Air direct/reverse	rev	dir	rev	rev	rev	rev
Product temp, ° C	21	32	30	27-31	28-35	32-39
Dew point, °CTP	0-+1	+1-+4	+3-+4	+4-+6	+4-+7	+4-+6
Air flow, m^3/h	4500	4500	4500	1000	1000	1000
Pressure diff, hPa	-2	-2	-2	-2	-2	-2
Syrup temp, °C	50	50	50	50	50	50
Drum speed, rpm	9	9	9	8-10	8-10	8-10
Process time, min	292	188	202	213	177	150

The following comments pertain to each of the tests separately:

1. Batch 1600/4 Standard Process/Comparative Example

This batch followed the coating procedure used as a standard. The bed temperature was 22°C. As would be expected with a standard procedure this batch did not cause any difficulties during the processing. The batch took 292 minutes to process. This is comparable to the times obtained during previous scale-up trials for a standard batch.

On tasting the samples 2 weeks after production the pellets had a good gloss, with a smooth surface and little or no corner loss. The pellets had an acceptably crunchy coating.

2. Batch 1600/3

This trial was comparable to the standard procedure except for the raised temperature. The direction of the air flow was reverse as in the standard procedure. Some problems were noted with dusting during processing. The dust created a dusty surface on the surface of the pellets, which appeared to prevent the syrup application from drying properly.

The syrup appeared to be crystallizing rapidly giving rise to a rough surface. Due to the roughness a pause period had to be incorporated into the process. The degree of dusting in combination with the pause period caused a sticky period during the process. A number of multiples formed within the pan.

Despite the dusting the process was about 30 % faster than the standard. The quality of the pellets was not as good as the standard.

3. Batch 1600/5

Direct air-flow was used in the process as opposed to the reverse air-flow utilised in the standard procedure. Direct air-flow reduces the effectiveness of the drying.

This batch followed an identical syrup dosage as applied during the standard batch. Changes were made during the processing whereby larger syrup applications could be made and drying times could be reduced significantly. Overall, this batch processed $\approx 35\%$ faster than the standard batch (188 minutes compared to 292 minutes for the standard). The batch also processed quicker than batch 1600/3.

The less efficient drying allowed a smoother coating to be applied and removed the need for pause periods during the process. On tasting the samples 2 weeks after production it was noted that these pellets had a smooth surface with little or no corner loss (as standard). These pellets had a good crunch, similar, if not slightly firmer, than the crunch obtained with the standard procedure.

Overall, the quality of the pellets remains as good, if not better, compared to the standard procedure. The process also offers a considerable time saving.

4. Batch 1200/4

This trial used lower initial syrup applications and a product temperature close to that desired (30°C). On completion the pellets were jogged in the pan for ≈30 minutes with the air flow on. The pellets were then polished in situ with Carnauba wax. The pellets were then allowed to run in an ambient airflow until an acceptable gloss had developed. The polished pellets were then unloaded and packed directly into cardboard boxes.

The reduced syrup applications and increased product temperature appeared to resolve all of the problems previously encountered with sticking and multiple formation. In order to achieve the desired product temperature of 30°C the drying air temperature had to be far higher at around 37°C to 40°C.

The finished coating was very smooth and quite glossy. However, most of the pellets had well-rounded corners, a sign of abrasion during the process. The finished coating was crisp with a good crunch equal to the standard.

5. Batch 1200/5

The product temperature was raised by 5°C, above that utilised for Trial 1200/4. The drying air temperature for this trial was set at a maximum of 45 - 48°C for much of the process. On completion the pellets were jogged in the pan for ≈30 minutes with the air flow on. A small quantity of pellets (≈20kg) were then polished using Carnauba wax. The pellets were then allowed to run in an ambient airflow until an acceptable gloss had developed. The polished pellets were then unloaded and packed directly into cardboard boxes.

Increasing the product temperature by 5°C throughout this trial appeared to significantly reduce any problems associated with stickiness during the drying phases of the process,

and to aid more rapid drying of the syrup coats. The more efficient drying of the syrup applications allowed total drying times to be reduced, resulting in a faster process than Trial 1200/4 (177 minutes versus 213 minutes).

The quality of the finished pellet coating did not appear to be effected by the changes in the protocol. The polished product had a slightly improved sheen over that observed for Trial 1200/4. Corner loss on the pellets was comparable between both batches. Crunchiness of the pellet coating was perhaps marginally superior to Trial 1200/4; otherwise there was little overall difference between the products.

6. Batch 1200/6

Working at this high temperature caused a number of processing difficulties with dusting and multiple formation. Despite this the finished product was very smooth although the surface finish was relatively dull. The products also exhibited significant corner loss.

The pellet crunch was not as crisp as that produced in trial 1200/4.

Example 7

Control of coating by relative humidity

A batch of chewing gum pellet centres were coated to a 50 % weight increase with the same syrups as those used in Examples 1-6. The initial layers were produced with an inlet air temperature of about 30 °C whereafter the inlet air temperature was raised to 40 °C for the actual coating. The change in relative humidity (RH) of the outlet air was monitored at the increased temperature phase.

The relative humidity of the outlet air had a basic level of about 12 % measured as the RH of the air in the outlet tube during the pause. The RH of the outlet air was found to increase rapidly during the first 30 seconds, whereafter it decreased slowly as indicated in Table 2.

The next cycle started well before the RH had reached the basis value of about 12 %.

Table 2

Relative humidity (%) of outlet air seconds after drying had started in the cycle.

Phase	basic	30 sec	60 sec	90 sec	120 sec	180 sec
2	11.8	26.1	19.0		14.5	13.4
5	12.7	30.0	22.2	17.4	15.5	
6	12.5	30.8			15.3	
7	12.1	31.2	27.0		16.0	
8	12.1	31.0	27.0	20.4	17	

The drying sequence was between 2 and 3 minutes and the Table shows that some moisture that could have been dried off from the layer was intentionally left in the layer. By this control procedure the process could be speeded up considerably while ascertaining that the layer did not over-dry to a point where dusting would disturb the coating surface.

Claims

1. A process for the hard panning of chewable cores in a coating pan or drum wherein a xylitol syrup is intermittently sprayed over a rotating bed of the cores and the cores are dried between sprayings with a flow of air, c h a r a c t e r i z e d in that

- the temperature of the bed of chewable cores is raised to a temperature of 25 to 45 °C, preferably 30 to 40 °C, for at least a part of said coating procedure,

- the drying during said part of the procedure is performed with air having a temperature of 25 to 75°C, preferably 30 to 65°C,

- the drying during said part of the procedure is controlled by controlling parameters of the drying air so as to prevent undue dusting and to obtain a hard and smooth coating with a good shelf life.

2. A process according to claim 1, wherein said parameters are selected from air flow rate, relative humidity and flow direction.

3. A process according to claim 1 or 2, wherein the relative humidity of the outlet air is higher than that of the inlet air.

4. A process according to claim 3, wherein the flow of inlet air is stopped when the relative humidity of the outlet air is 1-10, preferably 2-8 percentages higher than its basic level.

5. A process according to claim 1, wherein the direction of the air during said part of the procedure is direct, i.e. with the air flowing from above the bed through the product.

6. A process according to claim 1, wherein the bed temperature is 33 to 40 °C.

7. A process according to claim 1, wherein the inlet air temperature is 40 to 50 °C.

8. A process according to claim 1, wherein the syrup temperature is 40 to 80 °C.

9. A process according to claim 1, wherein the syrup contains 40 to 80% xylitol of the total weight.

10. A process according to claim 9, wherein the syrup contains 1 to 20% gum arabic of the total weight.

11. A process according to claim 9 or 10, wherein the syrup contains other polyols, flavors, pigments, special sweeteners and/or insoluble additives.

12. A process according to claim 11, wherein the syrup contains dissolved and/or suspended lactitol, maltitol, isomalt and/or mannitol.

13. A process according to claim 1, wherein the coating of the gum cores is started by an initial coating (sealing) sequence having a bed temperature lower than the bed temperature during said part of the coating procedure.

14. A process according to claim 1, wherein the coating of the gum cores is finished by an end coating sequence having a bed temperature lower then the bed temperature during said part of the coating procedure.

15. A process according to claim 13 or 14, wherein the direction of the flow of air during the initial and/or the end coating is reverse (flows from below the bed through the product).

16. A process according to claim 1, wherein the direction of the flow, the flow rate and/or the temperature of the air is changed several times during the coating procedure.

17. A process according to claim 1, wherein the coated cores are tempered after the coating for a time sufficient to allow crystallization of the xylitol in said coating to provide a crunchy hard coating.

18. A process for controlling the hard panning of chewable cores in a coating pan or drumwherein a syrup containing crystallizable sugars and/or polyol(s) is intermittently sprayed over a bed of the cores and the cores are dried between sprayings with a flow of air, c h a r a c t e r i z e d in that the control of the drying time is based on the relative humidity of the outlet air from the pan.

19. A process according to claim 18, wherein the relative humidity of the outlet air is higher than that of the inlet air.

20. A process according to claim 19, wherein the flow of inlet air is stopped when the relative humidity of the outlet air is 1-10, preferably 2-8 percentages higher than its basic level.

21. A chewable core panned by a process defined in claim 1 or 18.

22. A chewable core according to claim 21, wherein said panned core is a chewing gum coated with a hard coating of xylitol.

Abstract

The invention relates to a process for the hard panning of chewable cores in a pan or drum wherein a syrup of polyol such as xylitol is intermittently sprayed over a bed of the cores and the cores are dried between sprayings with a flow of air. The speed and effectivity of the panning process is increased by increasing the panning temperature. The problems encountered are solved by stricter control of the conditions. The chewable products are preferably xylitol coated chewing gums.